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NOTE ON THE HABITS OF *FIERASFER AFFINIS*

EDWIN LINTON

ON the 18th of June, 1906, at the Tortugas Laboratory of the Carnegie Institution I had the opportunity of watching an evicted Fierasfer in the act of returning to his lodging-place in a holothurian (*Stichopus mœbii*).

A record of this event, while perhaps not contributing anything new to science, will, it is hoped, be useful to teachers of zoölogy.

Perhaps as good a way as any of making this communication will be to narrate in order the series of events by which the knowledge came to the writer and at the same time to his associates in the laboratory, all of whom were interested witnesses.

The holothurian in question was found in a fish-trap and taken to the laboratory where it was placed in a large dish filled with sea water. Incidentally it may be remarked that the holothurian had been out of the water fully half an hour. It should also be stated that the holothurian was taken to the laboratory rather in response to the instinct of collecting than for the purpose of carrying on any experimental work.

The specimen was placed on my table and in the intervals of other work I placed various objects on it for the purpose of finding out whether it would get rid of them or not.

The holothurian was very contractile and varied in length from 150 millimeters, or less, up to the diameter of the dish, 300 millimeters.

It appeared to be indifferent to the presence of such objects as small glass dishes, allowing them to settle slowly into the yielding mass of its body wall. At length a finger-bowl, 115 millimeters

in diameter, was inverted over the animal, the edges resting on the dorsal side and about 30 millimeters from each end. Instead of making any effort to escape the animal retreated beneath the finger-bowl and at the expiration of 30 minutes had made no effort to escape.

At this point in the experiment, my patience proved inferior to that of the holothurian and I lifted the finger-bowl. When this was done a specimen of the interesting genus Fierasfer, which I have identified as *F. affinis*, was found. Evidently it had been driven to leave its host on account of the deficient supply of oxygen. The fish. which was nearly transparent, measured 124 millimeters in length, and was very slender, tapering almost uniformly from the head to the tip of the long and whip-like tail.

As soon as the finger-bowl was removed the fish began to swim

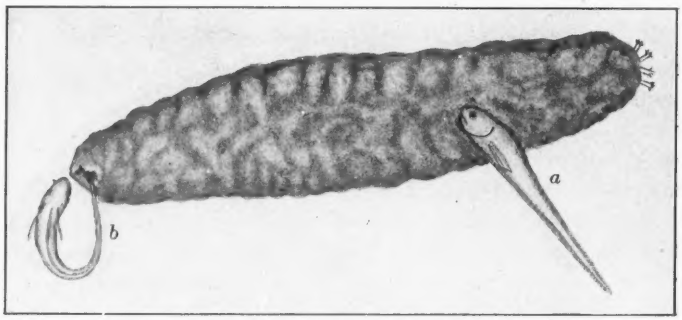

FIG. 1.— The figures represent the holothurian extended to the greatest length observed. All one-third natural size and diagrammatic.
a. Position of fish during its progress toward the posterior end of its host.
b. Fish at completion of movement which results in the insertion of the tail in the cloacal aperture.

actively about in the dish. It kept its nose close to the surface of the water, and at times even thrust its head above the surface in its eagerness to get oxygen.

After a few minutes it ceased to swim at the surface but appeared to be still uneasy. No test was made to prove what seemed to be indicated by its actions, *viz.*, that its sense of sight is defective. Judging from its subsequent behavior it was even then trying to find its customary quarters, but, to those of us who were watching, its movements began to be somewhat aimless.

At last, and, so far as I was able to judge, by accident, its nose came in contact with the holothurian near the anterior end. Immediately the fish appeared to become excited and began to feel its way back toward the posterior end of the holothurian. In its progress it bumped its nose rapidly against the side of the passive holothurian, and, as if following a scent, proceeded without any pause or regression toward the cloacal aperture. The instant that the nose of the fish touched the edge of the aperture, which was rather tightly closed, the slender tail was brought around with a very rapid whip-like movement, which terminated in a thrust whereby about 5 millimeters of the tip were darted into the narrow slit between the apposed lips of the cloaca. This movement was

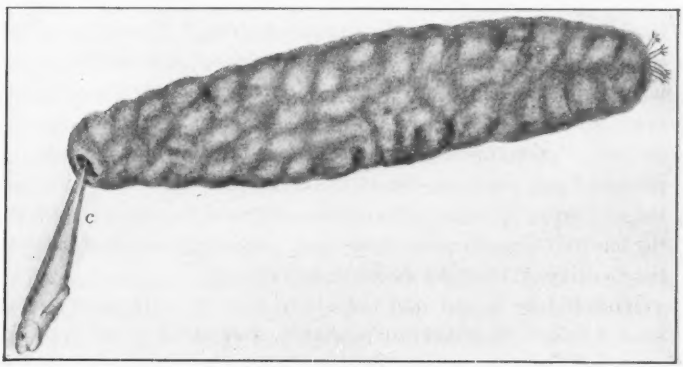

FIG. 2.— *c*. The fish has straightened and is beginning to insinuate itself into the body of its host.

effected while the nose of the fish was still touching the cloacal region.

Up to this time the fish had exhibited more or less excitement but as soon as the tip of its tail had been inserted it straightened itself and began leisurely to insinuate its body tail first into its host. In this process the fish appeared to be making some use of the spines of the dorsal and ventral fins. The motion was a slow, gliding one and was not dependent on the relaxing of the cloacal sphincter of the holothurian.

The lips of the cloacal aperture remained closed during the ingress except so far as they were forced apart by the body of the fish.

The time occupied by the fish in entering the holothurian was not taken, but in my notes which I made immediately after my observations, I find that I estimated the time to be probably not more than half a minute.

In order to give some of the workers in the laboratory, who had not seen all of the events described above, an opportunity to view this interesting instance of animal behavior, the experiment was repeated.

When the finger-bowl had been removed from the holothurian a second time the fish was found to be again in the water.

Then were repeated in minutest detail the actions which I have described above. The fish swam actively at the surface of the water—part of the time with its mouth above the surface. Then it began to move in a more or less aimless fashion. Finally it touched the holothurian with its nose, this time about the middle of the length. Then followed in exact order the reactions which had been observed before, *viz.*, the rapid bumping of its nose against the side of the holothurian, the undeviating progress towards the posterior end, the whip-like motion and insertion of the tail while the nose was still in contact with the margin of the cloacal aperture, the leisurely straightening of the body, and the gradual retreat into the resisting, at least not assisting, holothurian.

It should be added that the above account is made up from notes which I wrote down immediately after the observations were made. Except in one or two details they are confirmed by Dr. Ulric Dahlgren who has kindly placed his notes at my disposal.

The above account is the story of the way one Fierasfer gained entrance to its host. Whether every individual Fierasfer would behave exactly the same, under similar circumstances, perhaps does not necessarily follow.

I am indebted to Professor Cornelia M. Clapp for reference to an excellent article on the habits, anatomy, etc., of Fierasfer by Dr. Carlo Emery, (*Fauna und Flora des Golfes von Neapel*, vol. 1, 1880). Dr. Emery notes that Fierasfer enters its host tail first.

A somewhat similar habit is indicated for the common eel by what the veteran and accurate observer, Vinal N. Edwards, tells me, *viz.*, that eels go into holes tail first.

RECORDS OF PENNSYLVANIA FISHES

HENRY W. FOWLER

Two complete accounts of the fishes of Pennsylvania have appeared, one by Cope in 1881, and the other by Dr. Bean in 1892. The first of these is of a rather general nature, though based on the author's studies while collecting about the State, and the other is to a large extent little more than an elaborated compilation of the first. In view of the desideratum of definite records for the distribution of the different species in the various streams, lakes, etc., I have collected at a number of localities, and thus am able to offer nearly complete notes for some districts. This, and an examination of the fine collection of Pennsylvania fishes in the Academy of Natural Sciences of Philadelphia will complete my records. It may be understood that no species is here included unless known to me from the examination of a Pennsylvania specimen. Further exploration will undoubtedly extend the distribution of many species, besides resulting in the acquisition of some others not now known from within our limits.

The collections in the Academy embrace chiefly those made by E. D. Cope and J. H. Slack, together with others made by T. D. Keim, B. W. Griffiths, P. Lorrilliere, W. S. Sutch, S. P. G. Lindsay, D. McCadden, H. T. Wolff, Alfred Satterthwait, J. S. Witmer, W. Stone, and myself. In this connection the writer wishes to thank Mr. Wm. E. Meehan of the State Fish Commission for permission to collect fishes in Pennsylvania with nets.

PETROMYZONIDÆ

Petromyzon marinus Linnæus. LAMPREY.— Delaware River, in the Brandywine tributaries in the Delaware basin at Stock Grange, Chester Co. (W. Stone); at Holmesburg, Philadelphia Co., Cornwells, Bucks Co., Dingmans Ferry, Pike Co. (H. T. Wolff); apparently less frequent in the Delaware than formerly.

Ichthyomyzon concolor (Kirtland). SILVER LAMPREY.— Allegheny River at Port Allegany, McKean Co.

Lampetra wilderi Jordan and Evermann. BROOK LAMPREY. — Kiskiminitas River (E. D. Cope); Allegheny River at Port Allegany, McKean Co.; Susquehanna tributaries at Emporium, Cameron Co.

ACIPENSERIDÆ

Acipenser sturio Linnæus. STURGEON.— Delaware River at Holmesburg, Tacony, Bridesburg, and Torresdale, in Philadelphia Co., and Cornwells, Bristol, and Tullytown in Bucks Co. I have found it fairly abundant at times and seen some large examples.

POLYODONTIDÆ

Polyodon spathula (Walbaum). PADDLE FISH.— Reported as occurring occasionally in the Allegheny River below Corydon, Warren Co., which it has been known to ascend as far as Salamanca and Olean in Cattaraugus Co., N. Y.

PSALLISOSTOMATIDÆ

Psallisostomus osseus (Linnæus). GAR PIKE.— Small examples occur in the lower Delaware River as far as Morrisville, Bucks Co., and occasionally a large one is noted.

AMIIDÆ

Amia calva Linnæus. BOW FIN.— An example from Lake Erie, obtained by Dr. Watson, may have been taken within our limits.

GLOSSODONTIDÆ

Glossodon harengoides Rafinesque. MOON EYE.— Beaver River (E. D. Cope); Youghiogheny River (E. D. Cope).

CLUPEIDÆ

Pomolobus pseudoharengus (Wilson). ALEWIFE.— Delaware River at Tinicum, Delaware Co., Holmesburg, Tacony, and Torresdale, Philadelphia Co., and Cornwells, Croydon, Bristol, Tullytown, and Morrisville, Bucks Co. Abundant in the spring.

Alosa sapidissima (Wilson). SHAD.— Delaware River at Tinicum, Delaware Co., League Island, Frankford, Tacony, Holmesburg, and Torresdale, Philadelphia Co., Cornwells, Eddington, Croydon, Bristol, Tullytown, and Morrisville, Bucks Co., and Dingmans Ferry, Pike Co. (H. T. Wolff). Some seasons more abundant than others. In the Susquehanna they are taken about Peach Bottom and McCall's Ferry, Lancaster Co.

DOROSOMATIDÆ

Dorosoma cepedianum (Le Sueur). MUD SHAD.— Delaware River at Torresdale, Philadelphia Co. (Dr. H. D. Senior), and Cornwells, Bristol, and Tullytown, Bucks Co. Apparently less abundant than formerly, though even in midwinter a few have been hauled out of the mud.

ENGRAULIDIDÆ

Anchovia mitchilli (Valenciennes). ANCHOVY.— Many examples were obtained many years ago below Philadelphia, some most likely within our limits, by Dr. Colin Arrott. They occur in the lower Delaware and are more a feature of the marine fauna.

SALMONIDÆ

Salvelinus fontinalis (Mitchill). BROOK TROUT.— Brandywine tributaries in Chester Co., and those of the Schuylkill near Port Kennedy, Montgomery Co. (D. McCadden), all in the Delaware basin; the Susquehanna basin in the Loyalsock near Lopez, Sullivan Co., and near Galeton, Potter Co.; the Allegheny basin above Port Allegheny in McKean Co., and Seven Bridges in Potter Co.; the Genesee basin about Gold in Potter Co.

ARGENTINIDÆ

Osmerus mordax (Mitchill). SMELT.— I have seen a number of examples taken from the Schuylkill and Delaware near Philadelphia.

ANGUILLIDÆ

Anguilla chrisypa Rafinesque. EEL.— Delaware River at Tinicum and Darby Creek, Delaware Co., League Island, Frankford, Tacony, Holmesburg, Torresdale, with the Pennypack Creek basin at Bustleton, in Philadelphia Co.. Cornwells, Croydon, Bristol, Tullytown, and Morrisville, with the Neshaminy Creek basin at Hulmeville and Newtown, Bucks Co., and Dingmans Ferry, Pike Co. (H. T. Wolff); Susquehanna basin at Galeton, Potter Co. I did not meet with eels over the Allegheny divide in Potter and McKean Counties, and the impression is prevalent that they do not occur in the upper tributaries of either the Allegheny or the Genesee.

CYPRINIDÆ

Campostoma anomalum (Rafinesque). STONE ROLLER.— Allegheny River at Port Allegany, McKean Co., in June, 1906, where I found entirely tuberculated males; Kiskiminitas River (E. D. Cope).

Chrosomus erythrogaster eos (Cope). RED-BELLIED DACE.— Cotypes of *C. eos* Cope examined.

Hybognathus nuchalis Agassiz. SILVERY MINNOW.— Kiskiminitas River (E. D. Cope).

Hybognathus nuchalis regius (Girard). EASTERN SILVERY MINNOW.— Delaware River at Tacony, Holmesburg, and Torresdale, Philadelphia Co., and Cornwells and Bristol, also the Neshaminy Creek basin at Hulmeville and Neshaminy Falls, in Bucks Co. Many examples were examined.

Pimephales notatus (Rafinesque). BLUNT-NOSED MINNOW.— Kiskiminitas River (E. D. Cope) and the Allegheny River at Port Allegany, McKean Co., June, 1906.

Semotilus bullaris (Rafinesque). FALL FISH.— Delaware River basin in the Brandywine Creek basin at Kennett Square, Mendenhall, Willistown Barrens, and opposite Chadds Ford, Chester Co.; Darby Creek basin, Delaware Co.; Tacony, the Pennypack Creek basin at Holmesburg and Bustleton, the Poquessing Creek basin opposite Cornwells and Torresdale, Philadelphia

Co.; the Neshaminy Creek basin at Croydon, Hulmeville, Neshaminy Falls, and Newtown, Mill Creek basin about Bristol, and Tullytown Creek basin about Tullytown, Bucks Co.; Delaware Water Gap, Monroe Co. (E. D. Cope); Dingmans Ferry, Pike Co. (H. T. Wolff). In the Susquehanna basin I have it from the Northeast Creek at Nottingham, Chester Co., and the Conestoga Creek, Lancaster Co. (E. D. Cope).

Semotilus atromaculatus (Mitchill). CHUB. — Delaware River basin in the Brandywine Creek basin at Kennett Square, Mendenhall, and opposite Chadds Ford, Chester Co.; Cobb's Creek (E. D. Cope) and Darby Creek, Delaware Co.; Tacony Creek, the Pennypack Creek at Holmesburg and Bustleton, the Poquessing Creek at Torresdale and opposite Cornwells, Philadelphia Co.; the Neshaminy Creek at Croydon, Hulmeville, Neshaminy Falls, and Newtown, Mill Creek at Bristol, Tullytown Creek at Tullytown, and Morrisville, Bucks Co.; Dingmans Ferry, Pike Co. (H. T. Wolff). The Susquehanna basin in the Octoraro near Nottingham, Chester Co., and Muncy, Lycoming Co. Beaver River (E. D. Cope); Warren Co. (Dr. J. H. Slack); Kiskiminitas River (E. D. Cope); the Allegheny River at Raymonds, Potter Co. I have also found it in the headwaters of the Genesee around Gold, Potter Co.

Leuciscus vandoisulus Valenciennes. ROSY DACE. — Octoraro Creek, in the Susquehanna basin, near Nottingham, Chester Co.

Leuciscus elongatus (Kirtland). RED-SIDED DACE. — Allegheny River at Port Allegany, McKean Co., in June, 1906.

Brama crysoleucas (Mitchill). ROACH. — Delaware basin in the Brandywine Creek basin at Kennett Square, Mendenhall, and opposite Chadds Ford, Chester Co.; Tinicum and Darby Creek, Delaware Co.; Tacony Creek, the Pennypack at Holmesburg, and Bustleton, and the Poquessing at Torresdale and opposite Cornwells, Philadelphia Co.; Neshaminy Creek at Croydon, Hulmeville, Neshaminy Falls, and Newtown, Mill Creek at Bristol, Tullytown Creek at Tullytown, and Morrisville, Bucks Co.; Pennypack at Hatboro, Montgomery Co.; Daleville, Lackawanna Co.; Dingmans Ferry, Pike Co. (H. T. Wolff), and in the Susquehanna basin from the Loyalsock Creek near Lopez, Sullivan Co.

Notropis bifrenatus (Cope). BRIDLED MINNOW. — Delaware

River in the Brandywine at Chadds Ford, Delaware Co.; the Pennypack at Holmesburg and Bustleton in Philadelphia Co., and Hatboro in Montgomery Co.; the Poquessing at Cornwells, the Neshaminy at Croydon, Hulmeville, Neshaminy Falls, and Newtown, and Mill Creek at Bristol, Bucks Co. Abundant and rather local.

Notropis cayuga Meek. Cayuga Minnow. — I have already recorded the only example seen, which was taken near Port Allegany in 1904.

Notropis procne (Cope). Swallow Minnow. — Cotypes of *Hybognathus procne* Cope examined. I have examples also from the Delaware basin taken in the Schuylkill (E. D. Cope) and the Pennypack Creek near Holmesburg, Philadelphia. A small minnow was taken on one occasion, which may be this species, in the headwaters of Northeast Creek, near Nottingham, Chester Co., in the Susquehanna basin.

Notropis hudsonius amarus (Girard). Eastern Gudgeon. — Susquehanna basin at Paradise, Lancaster Co. (J. S. Witmer). Delaware basin in the Brandywine Creek at Chadds Ford, Delaware Co.; open river and Pennypack Creek at Holmesburg, and the Poquessing at Torresdale, Philadelphia Co.; Neshaminy Creek at Croydon, Hulmeville, and Neshaminy Falls, and Mill Creek at Bristol, Bucks Co. More abundant in the larger streams.

Notropis whipplii (Girard). Silver Fin.— Youghiogheny River (E. D. Cope) and Kiskiminitas River (E. D. Cope).

Notropis whipplii analostanus (Girard). Eastern Silver Fin. — Delaware River basin in the Brandywine Creek at Chadds Ford, and Darby Creek, Delaware Co.; Wissahickon Creek near Barren Hill, and Pennypack Creek near Hatboro, Montgomery Co.; Tacony Creek, Pennypack at Holmesburg and Bustleton, and Poquessing Creek at Torresdale and opposite Cornwells, Philadelphia Co.; the Neshaminy Creek at Croydon, Hulmeville, Neshaminy Falls, Frog Hollow, and Newtown, Mill Creek at Bristol, Tullytown Creek at Tullytown and Morrisville, Bucks Co.; Dingmans Ferry, Pike Co. (H. T. Wolff). It is also abundant in the Susquehanna basin where I received it from Paradise, Lancaster Co. (J. S. Witmer), and the Northeast Creek at Nottingham, Chester Co.

Notropis cornutus (Mitchill). RED FIN.— Delaware River basin in the Brandywine Creek at Kennett Square, Mendenhall, and opposite Chadds Ford, Chester Co.; Darby Creek and Ridley Creek near Willistown Barrens, Delaware Co.; Wissahickon Creek near Barren Hill, and the Pennypack at Hatboro, Montgomery Co.; Tacony Creek, Pennypack at Holmesburg and Bustleton, Poquessing Creek at Torresdale and opposite Cornwells, Philadelphia Co.; Neshaminy Creek at Croydon, Hulmeville, Neshaminy Falls, Newtown, Frog Hollow, and Chalfont, Mill Creek at Bristol, Tullytown Creek at Tullytown, and Morrisville, Bucks Co. In the Susquehanna basin in Northeast Creek at Nottingham, Chester Co.; Conestoga Creek (E. D. Cope) and Paradise, Lancaster Co. (J. S. Witmer), and Meshoppen, Elk Co. (E. D. Cope). In the Allegheny from near Croydon, Warren Co., and it also occurs farther up. Kiskiminitas River (E. D. Cope).

Notropis chalybæus (Cope). IRON-COLORED MINNOW.— Neshaminy Creek near Newton, and Mill Creek, Bristol, both in the Delaware basin, Bucks Co.

Notropis atherinoides Rafinesque. EMERALD MINNOW.— Beaver River (E. D. Cope).

Notropis rubrifrons (Cope). ROSY-FACED MINNOW.— Cotypes of *Alburnus rubrifrons* Cope examined.

Notropis photogenis (Cope). WHITE-EYED MINNOW.— Cotypes of *Squalius photogenis* Cope examined.

Notropis photogenis amœnus (Abbott). ATTRACTIVE MINNOW. — Hulmeville, in the Neshaminy Creek, Bucks Co.

Ericymba buccata Cope. SILVER-MOUTHED MINNOW.— Cotypes of the species examined.

Rhinichthys cataractæ (Valenciennes). LONG-NOSED DACE.— Delaware River basin in the Brandywine tributaries near Kennett Square and Mendenhall, Chester Co. In the Susquehanna at Paradise, Lancaster Co. (J. S. Witmer). Beaver River (E. D. Cope).

Rhinichthys atronasus (Mitchill). BLACK-NOSED DACE.—Delaware River basin in the Brandywine Creek basin at Kennett Square, Mendenhall, opposite Chadds Ford, Chester Co.; Darby, Ridley, and Cobb's Creeks, Delaware Co.; Schuylkill River, Tacony Creek, Pennypack Creek at Holmesburg, and Bustleton,

and Poquessing Creek at Torresdale, and opposite Cornwells, Philadelphia Co.; Wisahickon Creek near Barren Hill and Pennypack at Hatboro, Montgomery Co.; Neshaminy Creek at Croydon, Hulmeville, Neshaminy Falls, Frog Hollow, Chalfont, and Newtown, Mill Creek at Bristol, Tullytown Creek at Tullytown, Morrisville, Bucks Co.; Dingmans Ferry, Pike Co. (H. T. Wolff); Daleville, Lackawanna Co. In the Susquehanna basin it occurs in the Octoraro and Northeast Creeks near Nottingham, Chester Co.; Paradise in Lancaster Co. (J. S. Witmer); the Loyalsock Creek near Lopez, Sullivan Co., and Pine Creek at Galeton and above, Potter Co. In the Allegheny River it is abundant at Coudersport and Raymonds, Potter Co. Kiskiminitas River (E. D. Cope). Youghiogheny River (E. D. Cope). Genesee basin near Gold, Potter Co. Potomac drainage of Fulton Co., (W. Stone).

Hybopsis kentuckiensis (Rafinesque). HORNED CHUB.—Susquehanna basin in Elk Creek, Chester Co. (E. D. Cope); Conestoga Creek, Lancaster Co. (E. D. Cope). Beaver River (E. D. Cope); Youghiogheny River (E. D. Cope); Kiskiminitas River (E. D. Cope); Warren Co. (Dr. J. H. Slack); Allegheny River at Port Allegany, McKean Co.

Exoglossum maxillingua (Le Sueur). CUT-LIPS MINNOW.—Allegheny River at Port Allegany, McKean Co.

CATOSTOMATIDÆ

Carpiodes cyprinus (Le Sueur). EASTERN CARP SUCKER.—Conestoga Creek, in the Susquehanna basin, Lancaster Co. (E. D. Cope).

Cycleptus elongatus (Le Sueur). BLACK HORSE.—Kiskiminitas River (E. D. Cope).

Catostomus commersonnii (Lacépède). COMMON SUCKER.—Delaware River in the Brandywine tributaries at Kennett Square, Mendenhall and opposite Chadds Ford, Chester Co.; Tinicum, Ridley, Cobb's and Darby Creeks, Delaware Co.; Pennypack Creek at Hatboro, Montgomery Co.; Tacony Creek, Pennypack Creek at Holmesburg and Bustleton, Poquessing Creek at Torresdale and opposite Cornwells, Philadelphia Co.; Neshaminy Creek

at Croydon, Hulmeville, Chalfont, Frog Hollow, Neshaminy Falls, and Newtown, Mill Creek at Bristol, Tullytown Creek at Tullytown, and Morrisville, Bucks Co.; Delaware Water Gap, Monroe Co. (E. D. Cope); Dingmans Ferry, Pike Co. (H. T. Wolff). In the Susquehanna basin in the Northeast and Octoraro Creeks near Nottingham, Chester Co.; Conestoga Creek (E. D. Cope) and Paradise, Lancaster Co. (J. S. Witmer). In the Allegheny River it occurs at Port Allegany in McKean Co.

Catostomus nigricans Le Sueur. BLACK SUCKER.— In the Susquehanna basin in the Conestoga Creek (J. Stauffer) and at Paradise, Lancaster Co. (J. S. Witmer); Octoraro Creek near Nottingham, Chester Co. Kiskiminitas River (E. D. Cope). I have not positively identified this from the Delaware basin.

Erimyzon sucetta oblongus (Mitchill). MULLET. — Delaware River basin in the Brandywine tributaries at Kennett Square and Mendenhall, Chester Co.; Brandywine at Chadds Ford, Ridley and Darby Creeks, Delaware Co.; Tacony Creek, river and Pennypack Creek at Holmesburg and Bustleton, Poquessing Creek at Torresdale, and opposite Cornwells, Philadelphia Co.; Neshaminy Creek at Croydon, Hulmeville, Neshaminy Falls, and Newtown, Mill Creek at Bristol, Tullytown Creek at Tullytown, and Morrisville, Bucks Co. In the Susquehanna basin from Center Co. (Dr. H. Allport). Genesee River at Gold, Potter Co.

Moxostoma anisurum (Rafinesque). WHITE-NOSED SUCKER.— Beaver River (E. D. Cope) and Youghiogheny River (E. D. Cope).

Moxostoma aureolum (Le Sueur). GOLDEN RED HORSE.— Beaver River (E. D. Cope) and Youghiogheny River (E. D. Cope).

Moxostoma macrolepidotum (Le Sueur). RED HORSE.— Conestoga Creek, Lancaster Co. (E. D. Cope).

Moxostoma breviceps (Cope). LONG-TAILED RED HORSE.— Type of *Ptychostomus breviceps* Cope examined.

Placopharynx duquesnii (Le Sueur). BIG-JAWED SUCKER.— Beaver River (E. D. Cope).

SILURIDÆ

Ictalurus punctatus (Rafinesque). BLUE CAT.— Beaver River (E. D. Cope).

Ameiurus catus (Linnæus). WHITE CAT.— Delaware River

basin in tributaries in Chester Co. (V. Bernard); Holmesburg and Torresdale, Philadelphia Co.; Bristol, Bucks Co.; Susquehanna River (E. D. Cope).

Ameiurus nebulosus (Le Sueur). YELLOW CAT.— Delaware River basin in the Brandywine tributaries at Kennett Square and Mendenhall, Chester Co.; Tinicum, Brandywine at Chadds Ford, Darby, Ridley, and Cobb's Creeks, Delaware Co.; Jenkintown, Montgomery Co. (H. Crawley); Falls of Schuylkill (Dr. Uhler), Tacony Creek, river and Pennypack at Holmesburg and Bustleton, Poquessing Creek at Torresdale, and opposite Cornwells, Philadelphia Co.; Neshaminy Creek at Croydon, Hulmeville, Neshaminy Falls, Chalfont, and Newtown, Mill Creek at Bristol, Tullytown Creek at Tullytown, and Morrisville, Bucks Co.; Dingmans Ferry, Pike Co. (H. T. Wolff); Susquehanna River (E. D. Cope); Northeast Creek near Nottingham, Chester Co.; Conestoga Creek, Lancaster Co. (E. D. Cope); Allegheny River at Coudersport and Perryville, Potter Co.

Gronias nigrilabris Cope. BLIND CAT.— Cotypes of the species examined.

Leptops olivaris (Rafinesque). MUD CAT.— Youghiogheny River (E. D. Cope).

Schilbeodes gyrinus (Mitchill). TADPOLE STONE CAT.— Delaware River at Holmesburg, Philadelphia Co.; Mill Creek at Bristol, and Tullytown, Bucks Co.; Delaware Water Gap, Monroe Co. (E. D. Cope); Dingmans Ferry, Pike Co. (H. T. Wolff). In the Susquehanna from the Loyalsock Creek near Lopez, Sullivan Co. In the Genesee below Gold, Potter Co.

Schilbeodes insignis (Richardson). MARGINED STONE CAT.— Delaware River in the Schuylkill and at Holmesburg, Philadelphia Co.; Susquehanna basin at Carlisle, Cumberland Co. (S. F. Baird); Conestoga Creek (J. Stauffer) and Paradise, Lancaster Co. (J. S. Witmer).

ESOCIDÆ

Esox americanus (Gmelin). BANDED PICKEREL.— Delaware River basin in the Brandywine tributaries at Kennett Square and Mendenhall, Chester Co.; Tinicum and Darby Creek, Delaware Co.; Tacony Creek, Pennypack Creek at Holmesburg, and Poquessing Creek at Torresdale and opposite Cornwells, Philadel-

phia Co.; Neshaminy Creek at Neshaminy Falls and Newtown, Mill Creek at Bristol, Tullytown, and Morrisville, Bucks Co. In the Octoraro Creek of the Susquehanna basin near Nottingham, Chester Co.

Esox vermiculatus Le Sueur. WESTERN PICKEREL.— Allegheny River in Potter County.

Esox reticulatus Le Sueur. CHAIN PIKE.— Rock Hill Pond and Dingmans Ferry, in the Delaware Basin, Pike Co. (H. T. Wolff).

Esox lucius Linnæus. PIKE.— Although I did not secure any examples of this species in the Allegheny River while at Port Allegany, in McKean Co., in 1904, it was reported as occurring farther down stream. One from Lake Erie may have been from within our limits (Dr. Watson).

Esox masquinongy ohiensis (Kirtland). OHIO RIVER MUSKALLUNGE.— Reported to occur in the Allegheny as far as Corydon, Warren Co., and in New York to Olean. Warren Co. (Dr. J. H. Slack).

UMBRIDÆ

Umbra limi pygmæa (De Kay). MUD MINNOW.— Delaware River at Philadelphia and Holmesburg, Philadelphia Co.; Bristol and Tullytown, Bucks Co.; Schuylkill River (Dr. Harlan).

PŒCILIIDÆ

Fundulus heteroclitus macrolepidotus (Walbaum). MUMMICHOG. — Delaware River in tide-water, at Tinicum, Delaware Co.; League Island, Tacony, Holmesburg, and Torresdale, Philadelphia Co.; Cornwells, Croydon, Bristol, Tullytown, and Morrisville, Bucks Co.

Fundulus diaphanus (Le Sueur). BARRED KILLIFISH.— Delaware River in tide-water and above, Brandywine basin in Chester Co. at Kennett Square; Brandywine at Chadds Ford, Darby and Ridley Creeks, Delaware Co.; Tacony Creek, Pennypack Creek at Holmesburg and Bustleton, Poquessing Creek at Torresdale and opposite Cornwells, Philadelphia Co.; Neshaminy Creek at Croydon, Hulmeville, Neshaminy Falls, and Newtown, Mill

Creek at Bristol, Tullytown Creek at Tullytown, and Morrisville, Bucks Co.; Montgomery Co.; the Susquehanna basin at Paradise (J. S. Witmer) and Lancaster Co. (E. D. Cope); Warren County (Dr. J. H. Slack).

MASTACCEMBELIDÆ

Tylosurus marinus (Walbaum). GREEN GAR.— Delaware River (Dr. Uhler), at Bristol, Bucks Co.; Susquehanna River (E. D. Cope).

ATHERINIDÆ

Labidesthes sicculus (Cope). BROOK SILVERSIDE.— Youghiogheny River (E. D. Cope).

GASTEROSTERIDÆ

Eucalia inconstans (Kirtland). BROOK STICKLEBACK.— Erie, Erie Co.

Apeltes quadracus (Mitchill). FOUR-SPINED STICKLEBACK.— Delaware River, in tide-water, at Tinicum, Delaware Co.; Tacony, Holmesburg, and Torresdale, Philadelphia Co.; Cornwells, Croydon, Bristol, Tullytown, and Morrisville, Bucks Co.

APHREDODERIDÆ

Aphredoderus sayanus (Gilliams). PIRATE PERCH.— Delaware River at Tinicum, Delaware Co.; League Island, Tacony, Holmesburg, and Torresdale, Philadelphia Co.; Mill Creek and the river at Bristol, Bucks Co.

CENTRARCHIDÆ

Pomoxis annularis Rafinesque. CRAPPIE.— Kiskiminitas River (E. D. Cope). I have an example from the Delaware at Brownsville, Bucks Co. (J. G. Dillin).

Ambloplites rupestris (Rafinesque). ROCK BASS.— Beaver River (E. D. Cope), Warren Co. (Dr. J. H. Slack), and Kiskiminitas River (E. D. Cope).

Enneacanthus gloriosus (Holbrook). BLUE-SPOTTED SUNFISH. — Delaware River at League Island (Professor Wm. M. Gabb), and Holmesburg, Philadelphia Co.; river and Mill Creek at Bristol, Bucks Co. In the Susquehanna from the Conestoga Creek, Lancaster Co.

Enneacanthus obesus (Girard). SPHAGNUM SUNFISH.—Found only in the ditches of the lower part of Philadelphia along the Delaware.

Mesogonistius chætodon (Baird). BANDED SUNFISH.— Delaware River at Holmesburg, Philadelphia Co., and Bristol, Bucks Co.

Lepomis auritus (Linnæus). RED-BREASTED SUNFISH.— Delaware River basin in the Brandywine tributaries (Dr. H. Allen), Londongrove (E. D. Cope); Chadds Ford on the Brandywine, Darby, Ridley, and Cobb's Creeks, Delaware Co.; Montgomery Co. (W. Cassin), and Pennypack at Hatboro; Tacony Creek, Pennypack at Holmesburg and Bustleton, Poquessing at Torresdale and opposite Cornwells, Philadelphia Co.; Neshaminy Creek at Croydon, Hulmeville, Neshaminy Falls, and Newtown, Mill Creek at Bristol, Tullytown and Morrisville, Bucks Co.; Dingmans Ferry, Pike Co. (H. T. Wolff). In the Susquehanna basin from the Octoraro Creek (E. D. Cope) and Conestoga Creek, Lancaster Co. (E. D. Cope), and Paradise, Lancaster Co. (J. S. Witmer).

Lepomis megalotis (Rafinesque). LONG-EARED SUNFISH.— Kiskiminitas River (E. D. Cope).

Lepomis macrochirus Rafinesque. LARGE-FINNED SUNFISH. — Cotypes of *Lepomotis nephelus* Cope examined.

Lepomis palladus (Mitchill). BLUE-GILL SUNFISH.— Warren Co. (Dr. J. H. Slack); Kiskiminitas River (E. D. Cope).

Eupomotis gibbosus (Linnæus). COMMON SUNFISH.— Delaware River basin in tributaries of Brandywine near Kennett Square, Chester Co. (E. D. Cope and H. Allen); Brandywine at Chadds Ford, Ridley, Darby, and Cobb's Creek, and Tinicum, Delaware Co.; Jenkintown and Hatboro, Montgomery Co.; Tacony Creek, Pennypack Creek at Holmesburg and Bustleton, Poquessing at Torresdale and opposite Cornwells, Philadelphia Co.; Neshaminy Creek at Croydon, Hulmeville, Neshaminy Falls,

and Newtown, Bristol, and Mill Creek, Tuilytown and Tullytown Creek, and Morrisville, Bucks Co.; Dingmans Ferry, Pike Co. (H. T. Wolff). In the Susquehanna from the Conestoga Creek, Lancaster Co. (E. D. Cope); the Loyalsock near Lopez, Sullivan Co.; Octoraro Creek (E. D. Cope). Erie, Erie Co. (C. Rutter).

Micropterus dolomieu Lacépède. SMALL-MOUTHED BASS.— Youghiogheny River (E. D. Cope) and the Allegheny at Corydon, Warren Co., and met with as far as Olean, N. Y.

Micropterus salmoides (Lacépède). LARGE-MOUTHED BASS.— Warren Co.

PERCIDÆ

Stizostedion vitreum salmoneum (Rafinesque). BLUE PIKE.— Warren Co. (Dr. J. H. Slack), Beaver River (E. D. Cope), and Youghiogheny River (E. D. Cope).

Stizostedion canadense griseum (De Kay). SAUGER.— Warren Co. (Dr. J. H. Slack), Beaver River (E. D. Cope), and Youghiogheny River (E. D. Cope).

Perca flavescens (Mitchill). YELLOW PERCH.— Delaware River in Darby Creek, Delaware Co.; river and Pennypack Creek at Holmesburg, and Poquessing Creek at Torresdale, Philadelphia Co.; Neshaminy Creek at Croydon, Hulmeville, Neshaminy Falls and Newtown, Mill Creek at Bristol, Tullytown Creek at Tullytown and Morrisville, Bucks Co. In the Susquehanna basin from the Conestoga Creek in Lancaster Co. (E. D. Cope).

Percina caprodes (Rafinesque). LOG PERCH.— Type of *Perca nebulosa* Haldeman examined. Youghiogheny River (E. D. Cope) and Kiskiminitas River.

Hadropterus macrocephalus (Cope). LONG-HEADED DARTER. — Cotype of *Etheostoma macrocephalum* Cope examined.

Hadropterus peltatus (Cope). SHIELDED DARTER.— Type of *Etheostoma peltatum* Stauffer, in Cope, examined.

Diplesion blennioides (Rafinesque). GREEN-SIDED DARTER.— Beaver River (E. D. Cope).

Boleosoma nigrum (Rafinesque). JOHNNY DARTER.— Cotypes of *B. olmstedi brevipinnis* Cope examined.

Boleosoma nigrum olmstedi (Storer). TESSELLATED DARTER. — Delaware River basin in the Brandywine tributaries at Kennett

Square, Mendenhall and opposite Chadds Ford, Chester Co.; Brandywine at Chadds Ford, Ridley, Darby, and Cobb's Creek, and Tinicum, Delaware Co.; Pennypack at Hatboro, and Jenkintown, Montgomery Co.; League Island, Tacony Creek, Frankford Creek, Pennypack Creek at Holmesburg and Bustleton, and Poquessing Creek at Torresdale, and opposite Cornwells, Philadelphia Co.; Neshaminy Creek at Croydon, Newportville, Hulmeville, Neshaminy Falls, Frog Hollow, and Newtown, Mill Creek at Bristol, Tullytown Creek at Tullytown, and Morrisville, Bucks Co.; Dingmans Ferry, Pike Co. (H. T. Wolff). In the Susquehanna basin I have it from the Octoraro Creek at Nottingham in Chester Co., the Loyalsock near Lopez, Sullivan Co., and the Pequea at Paradise, Lancaster Co. (J. S. Witmer), besides the type of *Percina minima* Haldeman. The accompanying figure represents a remarkable variation of fin-rays seen in an example I secured at Holmesburg, Philadelphia, September 11th, 1898. Although I have not seen the type of *Boleosoma æsopus* Cope my Loyalsock examples go far to establish it as a pure synonym of this fish.

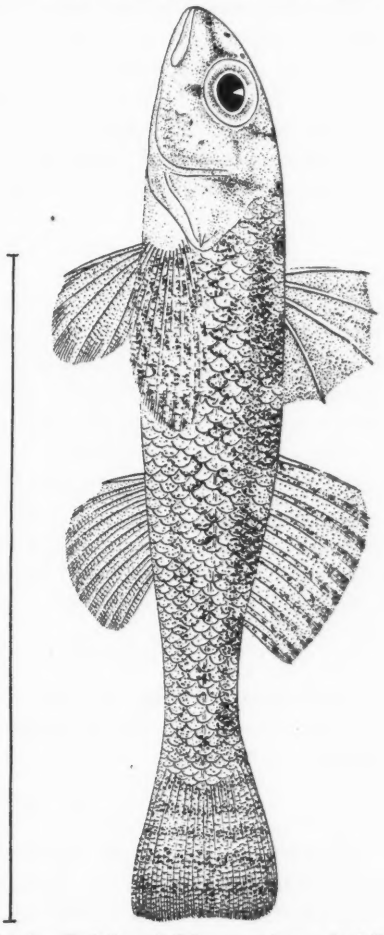

FIG. 1.— Variation of *Boleosoma nigrum olmstedi* (Storer).

Etheostoma cæruleum Storer. BLUE DARTER.— Kiskiminitas River (E. D. Cope).

Etheostoma flabellare Rafinesque. FAN-TAILED DARTER.— Kiskiminitas River (E. D. Cope); Youghiogheny River (E. D. Cope); Pittsburgh (Jacob Green); Allegheny River at Port Allegany in McKean Co. during July and August of 1904 and June of 1906, where it is abundant.

Boleichthys fusiformis erochrous (Cope). SPHAGNUM DARTER. — Delaware basin in Mill Creek near Bristol, Bucks Co.

SERRANIDÆ

Roccus lineatus (Bloch). STRIPED BASS.— Delaware River basin at Tinicum, Delaware Co.; League Island, Tacony, Holmesburg, and Torresdale, Philadelphia Co.; Cornwells, Bristol, Tullytown, and Morrisville, Bucks Co. In the Susquehanna basin I have it from the Conestoga in Lancaster Co. (E. D. Cope).

Roccus chrysops (Rafinesque). WHITE BASS.— Reported from just below the headwaters of the Genesee in Potter Co. near Gold.

Morone americana (Gmelin). WHITE PERCH.— Delaware River at League Island, Tacony, Holmesburg, and Torresdale, Philadelphia Co., Cornwells, Bristol, Croydon, Tullytown, and Morrisville, Bucks Co.

SCIÆNIDÆ

Aplodinotus grunniens Rafinesque. FRESH-WATER DRUM.— One from Lake Erie (Dr. Watson) may have been taken in our limits.

COTTIDÆ

Uranidea gracilis viscosa (Haldeman). MILLER'S THUMB.— The Delaware basin in the Brandywine tributaries near West Chester, Chester Co.; in the Schuylkill basin near Port Kennedy, Montgomery Co. (D. McCadden), and Douglassville, Berks Co. (S. N. Rhoads); in the Neshaminy basin near New Britain, Bucks Co. (Dr. C. C. Abbott). In the Susquehanna basin in Spruce Creek, Huntingdon Co. In the Genesee basin at Gold, Potter Co., also other examples from the same County (E. Harris).

SOLEIDÆ

Achirus fasciatus Lacépède. SOLE.— Schuylkill River in the Delaware basin (Dr. Harlan) and Bristol, Bucks Co. (Dr. J. De B. Abbott).

GADIDÆ

Lota maculosa (Le Sueur). LING.— Erie, Erie Co.; Susquehanna basin at Muncy, Lycoming Co. (E. D. Cope).

SPECIFIC NAME OF *NECTURUS MACULOSUS*

F. C. WAITE

In view of the fact that this animal is now extensively used in research and teaching, and since the majority of teachers and writers follow Cope ('89) and erroneously use the name *Necturus maculatus*, it seems worth while to call attention to the correct terminology.

There has been considerable confusion in the nomenclature of this form since it was first described. Minor variations have in several cases received specific names, and in the earlier literature it was frequently confused with *Cryptobranchus allegheniensis* of which it was for a time considered the larva.

The first scientific description of this animal was by Schneider in 1799 from a single specimen in the museum at Brunswick. This specimen came from Lake Champlain. Schneider did not consider it a new genus but put it under the European genus Salamandra without appending any specific name.[1]

Lacépède ('07) described a museum specimen, saying that it had never been before described, evidently not knowing of Schneider's description. He recognized that it differed from Salamandra and therefore referred it to the genus Proteus, naming it *Proteus tetradactyle* with the provision that if it were found to be a larva, it should be called *Salamandra tetradactyle*.

Barton ('07, pp. 196–7), describes "a large species of Salamandra" which he proposes to call *S. horrida*, or *maxima*, or *gigantea*. It is evident from a reading of his paper that he has confused Necturus and Cryptobranchus, and the general inaccuracy of his description makes his contribution of little value.

Rafinesque ('18, p. 40), gave a brief preliminary description of this salamander under the name *Sirena maculosa*. He, however, recognized, as the following quotation shows, that it might represent a new genus (p. 40): "In Zoology my discoveries are par-

[1] The original paper is not available. I quote from Holbrook ('42).

ticularly important consisting of about 25 new undescribed quadrupeds, 30 new birds and about 32 new reptiles" * * * * "Among so many undescribed things it must follow that several may constitute new genera.... I propose to select 8 N. G. and 10 N. Sp. in order to convey an idea of the whole.

(p. 41) I. N. Sp. Sirena maculosa, (A Reptile). Body olivaceous brown, covered with large unequal blackish spots * * * * "This spotted siren bears the generic name *Water Puppet* along with S. lutea and S. fusca."

A year later, after he had been able to study his collections, Rafinesque ('19) erected the new genus Necturus to include this form. I quote part of his description, (p. 418): "IIIe Classe. Reptiles * * * * 7. Necturus (Batracien) Different des genres *Salamandra, Triturus* (Triton, Laur.), *Larvarius* (Proteus, Aurt.), par queue comprimée 4 doigts séparés a tous les 4 pieds, branchies extérieures persistent communement jusqu' à la vieillesse. .... Espèces: N. maculatus, N. lutescens, N. fuscus, N. marginatus, N. axolotes?, N. anguillaris, N. operculatus, etc."

A year later Rafinesque ('20) again describes this form, (p. 4): "III Class. Erpetiá — the Reptiles....17. Necturus maculosus, olive brown covered with large unequal black spots.... My genus *Necturus* (70 N. G. An.) is distinguished from *Triturus* by having teeth, four toes to all the feet and external gills present to a late period....18. Necturus luteus....19. Necturus phosphoreus" * * *.

Mitchill ('21, p. 183) says in regard to this form: "From such survey as I have been capable of making I am inclined to consider him a Proteus; but of a species different to that known to European naturalists." Later, in a very extensive description with good plate, (Mitchill, '24) he describes a specimen from Lake Erie and recognizes that it differs from the genus Proteus, but is "averse to unnecessary multiplication of genera."

In 1823 Say (James, '23, vol. 1, p. 5, footnote) describes specimens from the Allegheny River, with permanent branchiæ. He says that it is caught at Pittsburg but is not so abundant as *S. alleghe-niensis.* He gives the new name *Triton lateralis.*

Harlan ('24, p. 233, pl. 16), evidently unaware of the papers of Rafinesque, erected the new genus Menobranchus. "The *Am-*

phiuma, the *Siren*, the *Proteus* and the *Salamandra* will be acknowledged by all to constitute separate genera. The *lateralis* and *allegheniensis* not belonging to any of these will require appropriate generic names.... As the most prominent feature distinguishing the *T. lateralis* from the *Salamandra* is its persistent branchiæ, we have preferred a name significant of this fact. Menobranchus. Generic characters. Persistent branchiæ, two rows of teeth in the upper and one row in the lower jaw; four footed, four toes to each foot, clawless." He describes two species, *M. lateralis* and *M. tetradactylus*. Since these were found to be but variations of the same species and since the term *tetradactylus* described a generic character, the first species, only, held.

Harlan erected the genus Abranchus to include the *allegheniensis*, but in a note a few months later (same journal and volume, p. 270) he changed this to Menopoma having learned that the name Abranchus was preëmpted for a genus of nudibranch molluscs.

Barnes ('26) calls it *Proteus lateralis* and says (p. 287) that "the first specific name given was by Mr. Say who called it *lateralis* in allusion to the black lateral line. The discoveries already made .... show that the character from which he derived this is variable." He dissents from Harlan and does not think that a new genus should be established. He evidently knew nothing of Rafinesque's description.

In a later note (Barnes, '27, p. 68), he says: "Dr. Mitchill has laterly called it *Proteus maculatus*, which as it is a good descriptive name.... I am disposed to adopt." Mitchill had evidently gotten the *maculatus* from Rafinesque's second paper ('19) but had not seen the first ('18) or third ('20) papers.

Fitzinger ('26, p. 43) gave a new name to the genus. "Genus. Phaenerobranchus. Aus Lacépède's Proteus tetradactylus, Say's Triton lateralis, aus Nord Amerika, schuf ich die Gattung Phaenerobranchus (Menobranchus, Harlan; Necturus, Rafinesque)." Under the list of reptiles in the Zoölogical Museum at Vienna he includes (p. 66) "Phaenerobranchus cepedii (=Proteus tetradactylus, La Cepede)."

Harlan ('27) in his synopsis includes (p. 323) "*Menobranchus lateralis*" and this name was followed by many writers.

Wagler ('30, p. 210) returns to the generic name of Necturus,

and quotes as synonyms, *Proteus tetradactylus* Lacépède, *Triton lateralis* Say, and *Menobranchus lateralis* Harlan.

Tschudi ('38, p. 97) adopts *Menobranchus lateralis.*

Holbrook ('42, vol. 5) describes two species of Menobranchus: (p. 111) *M. maculatus* (Barnes) in which he makes no reference to Rafinesque, and (p. 115) *M. lateralis* (Say). He states that the two species may be only geographical varieties.

DeKay ('42, p. 87, pl. 18, fig. 45) uses *Menobranchus lateralis* and does not refer to Rafinesque.

Baird ('50), in his "Revision of the Tailed-Batrachia" gives correct references to Rafinesque's three papers and while adopting his generic name, adheres to Say's specific name (which was given five years later) giving the name of the form as *Necturus lateralis* 1823, which was the date of Say's description, although Say did not use the term Necturus.

Gray ('50) gives the reference to Rafinesque's three papers and is the first to adopt the correct name *Necturus maculosus.* However, in the second edition of this work (Boulenger, '82, p. 84) reference is made only to Rafinesque's second ('19) paper and the term *Necturus maculatus* is taken.

Dumeril and Bibron ('54, p. 183) use Harlan's term *Menobranchus lateralis.*

Finally, Cope ('89, p. 23) adopts the name *Necturus maculatus* in spite of the fact that his references to synonyms shows that he had consulted all of Rafinesque's papers.

The following are part of the Laws of priority as published in the *International Rules of Nomenclature* (:05):—

(p. 35) "Art 25. The valid name of a genus or species can be only that under which it was first designated on the condition: (*a*) That this name was published and accompanied by an indication or a definition or a description and (*b*) That the author applied the principles of binary nomenclature."

(p. 36) "Art. 28. A genus formed by the union of two or more genera or subgenera takes the oldest valid generic or subgeneric name of its components. The same rule obtains when two or more species or subspecies are united to form a single species or subspecies.

(p. 37) "Art. 32. A generic or a specific name once published

cannot be rejected even by its author because of inappropriateness."

Although Schneider gave the first description of this form he did not follow the binary system nor did he recognize it as a separate genus.

There can be no question that Rafinesque ('19) was the first to erect and name a new genus to receive this form.

The specific name *tetradactylus* given by Lacépède ('07) cannot hold because it describes a generic character ("4 doigts séparés à tous les 4 pieds") in the new genus Necturus of Rafinesque.

The description by Barton ('07), is certainly so inaccurate, including his hesitation between three specific names, that his paper can have little weight.

The first scientific description with the use of a binary nomenclature is that of Rafinesque ('18). Here the specific name is *maculosa*. According to Art. 32 of the rules on priority this term could not have been changed by Rafinesque if he had wished to do so. The term *maculatus* used in his 1819 paper is either an unintentional slip on his part or a typographical error. At any rate the use of the term *maculosus* in his '20 paper, which was published under his immediate direction with opportunity to correct proof, shows that he preferred the original adjective form *maculosus* to the participial form *maculatus*. Such is certainly the better grammatical usage.

The confusion has arisen from the fact that the first ('18) paper was printed in a rather obscure literary periodical where scientific men were unlikely to see it. Likewise the third paper ('20) was published in an obscure private publication, a serial which did not continue and so was easily lost sight of. The second paper ('19) in which the error occurred was in a prominent scientific journal and thus came to be generally known.

In the past ten years although many papers have been written on Necturus, two only have, as far as I know, used the correct nomenclature. These are Eycleshymer (:06) and Waite ('97).

I believe that it is clear from the foregoing that the correct name is *Necturus maculosus* and I hope that this may come into general use.

Western Reserve University.

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VOLVOX FOR LABORATORY USE

BERTRAM G. SMITH

In providing a supply of Volvox for class use late in the fall, difficulty has been experienced in two respects: in keeping the material alive in the laboratory as long as desired, and in getting specimens containing sperm and ova. Inquiry reveals the fact that others have had the same trouble. I have recently been able to overcome both these difficulties, and at the suggestion of Dr. H. H. Newman have recorded the method in some brief notes.

Species.—So far as known, the only species of Volvox that has been found in the vicinity of Ann Arbor during the late autumn is *Volvox aureus* Ehrenb. It is not very abundant, and I have never found it in the sexual stage at the time it was collected. It occurs in small glacial pools containing Riccia and duckweed.

During the early spring *Volvox globator* Linn., and no other species, occurs in great abundance in the same pools that later contain *Volvox aureus*. I have occasionally found it in the sexual stage when collected.

By the latter part of June *Volvox globator* has become quite scarce, and *V. aureus* has begun to appear. During the early part of July the two species exist in the same habitats, but neither is very abundant.

Since Volvox is so widely used for laboratory work by beginning classes, the marked specific differences are matters of importance. *Volvox globator* is the form described in text-books, but the description is far from being applicable to *V. aureus*. Since the latter may at times be the only species available, it may be profitable to call attention to the differences between the two species, for it is to be suspected that *Volvox aureus* is sometimes used without its species being recognized.

Volvox globator is considerably larger than *V. aureus*; its somatic cells are more numerous and compactly arranged. The somatic cells of *globator* are angular and connected by very stout protoplasmic strands; the somatic cells of *aureus* are round when seen

from the surface, and connected by very slender protoplasmic strands, difficult for students to make out under the microscope. *Volvox globator* is monœcious: in the sexual stage both sperm bundles and eggs may be found in the same colony at the same time. The number of sperm bundles in a single colony is small. *Volvox aureus* is either diœcious or monœcious proterogynous: sperm and eggs are never found together in a single colony at the same time, but the colony may contain one or the other exclusively. However, I have found daughter colonies, some of which contained bundles of sperms, others ova, within the same parent colony. The number of sperm bundles in a single colony is very large. *Sphærosira volvox* Ehrenb. is an old name for the male colony of *Volvox aureus*.

Kofoid ('99) gives the following key for the determination of the two species:

Cells about 10,000 (minimum 1,500, maximum 22,000), angular with stout connecting protoplasmic processes into which the chromatophore may enter. Diameter of colony about 700 μ (minimum 400, maximum 1,200); diameter of cell body 3–5 μ. *V. globator* L.

Cells 500–1000 (minimum 200, maximum 4,400); rounded, with slender connecting protoplasmic processes into which the chromatophore does not enter. Diameter of colony 170–180 μ; diameter of cell body 5–80 μ. *Volvox aureus* Ehrenb.

Klein ('99) gives illustrations of the general appearance of the two species, including reproductive stages. Meyer ('96) gives details of cell structure, with illustrations.

Volvox globator is probably a better form for laboratory work than *V. aureus*, and can be obtained in greater abundance if secured early in the spring. Hence if Volvox is to be studied in the fall by large classes it is well to preserve this species in 4% formalin in the spring; for many purposes the preserved material, if not kept too long, is as good as the living. The study of preserved specimens of *V. globator* can then be supplemented by the living *V. aureus*.

Keeping Volvox alive in the Laboratory.— Terry (:06) in experimenting on the galvanotropism of Volvox met with the usual difficulty in keeping it alive in the laboratory, and concluded that the organisms died of insufficient nourishment caused by improper

food supply and poor light, but found it impossible to regulate either so that they would live for more than four days. My own experience has convinced me that in our laboratory one of the principal causes of the death of the organism has been injurious mineral substances in the tap water in which the specimens were kept.

In collecting Volvox for our laboratory it has been customary to bring in considerable quantities of vegetable material (duckweed, Riccia, etc.) from the ponds in which Volvox occurred, along with a little water, and place this material in shallow glass dishes filled with tap water. As fast as the organisms gathered on the lighted side of the dish they were picked off and removed to a dish of clean tap water, it being deemed unsafe to leave them in the original dish exposed to the attacks of crustaceans. Suspecting that deleterious substances in the tap water, as well as the lack of a proper food supply, caused the death of the organisms, I made an attempt to reproduce the natural conditions. Water containing Volvox was brought in in considerable quantities, together with a small amount of the vegetable material, and placed in shallow glass dishes without the addition of tap water. The dishes were placed near windows and covered with glass plates to prevent loss of water by evaporation and to keep out bacteria and fungi, except that when exposed to direct sunlight it was found advisable to leave room for circulation of air between the cover and the dish to prevent a rise of temperature beyond the optimum. The water was not changed at any time during the course of the experiment. In the majority of the aquaria thus prepared, Volvox flourished for several weeks; in the fall of 1905, *Volvox aureus* was kept alive in several aquaria for from four to eight weeks; less success was attained with *Volvox globator* in the spring, but it was kept alive in most cases for about two weeks.

It was noted that *Volvox globator* clusters about decaying insect larvæ, perhaps on account of the presence of carbon dioxide. A moderate amount of decaying plant or animal material in the water seems to be one of the essential conditions for its existence. In its natural environment, Volvox is often found in decidedly stagnant water.

Temperature is an important factor to be considered in caring

for Volvox. It is more difficult to keep the material alive in the laboratory during warm weather because, in exposing the dishes to sunlight, the water is likely to become warmer than that of the ponds in which Volvox lives. This difficulty might be overcome by placing the dishes where they will be partly immersed in the running water of a shallow aquarium, and at the same time receive an abundance of sunlight.

In case organisms that feed upon Volvox are too abundant, the latter may be freed from its enemies by removing it with a pipette when clustered at the lighted side of the dish, to a dish of pond water strained through bolting cloth to remove crustaceans, etc.

Obtaining Volvox in the Sexual Stage.— Both in the fall and in the spring, material in the sexual stage was obtained in abundance merely by keeping the organisms alive in the laboratory. Several aquaria should be set up, and in some of them, specimens in the sexual stage will usually be found in the course of one or two weeks. It was noted by Dr. H. H. Newman that they often remain hidden in the ooze at the bottom of the dish. When they reach the sexual stage they seem to become less motile and consequently drop to the bottom. This is especially true of sperm colonies in *V. aureus*.

UNIVERSITY OF MICHIGAN
ZOOLOGICAL LABORATORY
ANN ARBOR, MICHIGAN

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OSTRACODA FROM SOUTHEASTERN MASSACHUSETTS

JOSEPH A. CUSHMAN

THAT the Ostracoda of New England have been greatly neglected may at once be seen by a reference to Miss Rathbun's list of the New England Crustacea. At the time of its publication there was a single species reported from New England and that from but one locality. With a view to supplying this lack of records in a slight measure, some collecting has been done in our ponds, mainly about Boston. Several persons have kindly supplied material which has now been placed in the collections of the Boston Society of Natural History. Seven species are reported here, making the number of species now known from the fresh water of New England, nine instead of one. All of the records so far, however, are from Massachusetts.

It has been a matter of interest to find the local distribution of the species. Where a species is found at all it is usually abundant. Of the three species of Cypris reported, all were found in ponds in the vicinity of Boston and but a short distance apart, yet no one collection contained more than a single species.

A number of other species have been collected but in immature condition or in insufficient numbers for complete diagnosis.

The measurements given are average ones for the material examined. As a rule, if adults alone are taken there is a noticeable constancy in measurements but in cases where the collection contains the young also, the range in measurements is considerably greater.

It is to be hoped that more collecting will be done in the near future and over a much broader region. By this means a considerable addition to the present list should be made. The seven species representing five genera are given below.

Family *Cyprididæ*

Subfamily Cypridinæ

Genus SPIROCYPRIS Sharpe, 1903

1. **Spirocypris passaica** Sharpe

Length 1.54 mm., height 0.76 mm., breadth 0.78 mm.

Spirocypris passaica Sharpe, *Proc. U. S. Nat. Mus.*, vol. 26, 1903, p. 982, pl. 66, figs. 1–3.

This species and genus were described as new from material in the U. S. National Museum, collected at Passaic, New Jersey. There is no other record for it, as far as I know, up to the present. It is especially interesting, therefore, to be able to record this species from Massachusetts. Several specimens were obtained from Wellesley, Mass., April 20, 1905, collected by Mr. Irving L. Shaw.

The Massachusetts specimens were very slightly smaller than the types but otherwise the specimens agreed very well. The peculiar arrangement of the testes in concentric circles is very apparent and striking. The original description gives the furca as 23 times as long as wide. In the specimen measured from Massachusetts the length was 0.486 mm. and the breadth 0.021 mm. A closer ratio of 23:1 could hardly be obtained in such a structure. Further collecting may show this species to be widely distributed in New England.

Genus CYPRIS O. F. Müller, 1792

2. **Cypris virens** (Jurine)

Monoculus virens Jurine, *Histoire des Monocles, qui se trouvent aux Environs de Genève*, 1820, p. 174, pl. 18, figs. 15–16.

Cypris virens Zaddach, Synopseos Crustaceorum Prussicorum Prodromus, 1844, p. 35.

Length 1.70 mm., height 0.97 mm., breadth 0.90 mm.

Arlington, Mass. May 7, 1905. A. S. Pearse, coll.

This is a very widely distributed species and should be found throughout New England as collecting is extended. It was represented in considerable numbers in the material examined.

3. **Cypris fuscata** (Jurine)

Monoculus fuscatus Jurine, *l. c.*, 1820, p. 174, pl. 19, figs. 1, 2.
Cypris fuscata Zaddach, *l. c.*, 1844, p. 32.

Length 1.36 mm., height 0.81 mm., breadth 0.75 mm.

Near Fresh Pond, Cambridge, Mass. April 30, 1905. J. A. C., coll.

In a very shallow pond-hole this species was very abundant on the date given. As in the case of the preceding species, this is very widely distributed and should be found throughout New England.

4. **Cypris reticulata** Zaddach

Cypris reticulata Zaddach, *l. c.*, 1844, p. 34.

Length 1.20 mm., height 0.70 mm., breadth 0.60 mm.

Brookline, Mass. April 10, 1905. Irving L. Shaw, coll.

Although this species is a very characteristic one and is widely distributed in Europe, its occurrence in this country has hitherto rested upon the single record of Dr. Sharpe. He found it in great numbers at Normal, Ill., in a small grassy pool. It seems to prefer such a habitat and therefore may be looked for in New England in such places. The species was abundant in the collection from Brookline.

Subfamily Cypridopsinæ

Genus Cypridopsis Brady, 1868

5. **Cypridopsis vidua** (O. F. Müller)

Cypris vidua O. F. Müller, *Entomostraca seu Insecta testacea, quae in aquis Daniae et Norvegiae reperit, descripsit et iconibus illustravit*, 1792. p. 55, tab. 4, figs. 7–9.

Cypridopsis vidua Brady, "A Monograph of the Recent British Ostracoda," *Trans. Linn. Soc. London*, vol. 26, pt. 2, 1868, p. 375, pl. 24, figs. 27–30, 46.

Length 0.64–0.75 mm., height 0.38–0.42 mm., breadth 0.42–0.47 mm.

Small pond, West Cambridge, Mass. April 30, 1905. J. A. C., coll.

In tap water from Fresh Pond, Cambridge, Mass. Aug. 12, 1905. A. S. Pearse, coll.

Cohasset, Mass. Oct. 22, 1906. Owen Bryant, coll.

This species should be found everywhere in all kinds of fresh water. It is probably the most abundant and one of the most widely distributed of our fresh-water ostracods. It may be overlooked on account of its small size.

Subfamily Cyclocypridinæ

Genus CYPRIA Zenker, 1854

6. **Cypria exsculpta** (Fischer)

Cypris exsculpta Fischer, "Beitrag zur Kenntniss der Ostracoden," *Abhandl. math. phys. Klasse k. bayr. Akad. d. Wiss.*, vol. 7, 1855, p. 18, pl. 19, figs. 36–38.

Cypria exsculpta Brady and Norman, "Monograph of the Marine and Freshwater Ostracoda, Sec. I," *Trans. Roy. Dublin Soc.*, ser. 2, vol. 4, 1889, p. 68, pl. 11, figs. 1–4.

Length 0.68 mm., height 0.44 mm., breadth 0.28 mm.

Woods Hole, Mass. Abundant in fresh-water pond, June 25, 1905, A. S. Pearse, coll. July 15, 1906, J. A. C., coll. Auburndale, Mass., Oct. 28, 1906, C. W. Johnson, coll.

This species is almost as widely distributed and abundant as the preceding. It should be found throughout New England.

Subfamily Candoninæ

Genus CANDONA Baird, 1850

7. **Candona candida** (O. F. Müller)

Cypris candida O. F. Müller, *l. c.*, 1792, p. 62, tab. 6, figs. 7–9.

Candona candida Lilljeborg, *De Crustaceis ex ordinibus Tribus*, 1853, p. 127, pl. 11, figs. 19–20, pl. 25, figs. 13–15.

Length 0.86–1.39 mm., height 0.45–0.66 mm.

Arlington, Mass., May 7, 1905, A. S. Pearse, coll.; Auburndale, Mass., Oct. 28, 1906, C. W. Johnson, coll.

This species has not been reported from America as far as I am aware. The specimens seem to agree well with the European

figures and descriptions and seem to be that species without doubt. There is a very considerable range in the measurements given as many young specimens and both sexes were in the lot measured. An average measurement would be close to the maximum given here, if adults alone were taken.

This species, like the others of its genus, has a crawling habit and may be in this way overlooked in collecting and in the examination of fresh material. It was not abundant in either of the two collections in which it was found.

Boston Society of Natural History, November, 1906.

NOTES AND LITERATURE.

PHYSICS.

A First Course in Physics.[1] — These two books outline a thoroughly substantial course in elementary physics. They are obviously intended to be used together, but each is complete in itself and either (preferably the laboratory manual, as the authors themselves say in their preface) could be used alone as the basis of a shorter course.

The essential feature of these books is their emphasis on the necessity of showing a student "the hows and whys of the physical world in which he lives" as well as the "how much" to which the reaction from "the superficial, descriptive physics of thirty years ago" has led us. For this reason, a great number of devices which are in common use are explained with the help, in many cases, of admirable diagrams of actual machines; as examples we may mention platform scales for wagons, gas meters, two kinds of hydraulic elevators, the fire engine, the railroad locomotive, hydraulic and steam turbines and gas engines, artificial-ice and liquid-air machines, an excellent discussion of the modern methods of heating and ventilating houses, a full description not only of the instruments used in telegraphy and telephony, including the carbon transmitter, but also of the circuits themselves, including even the new Bell central-battery system of telephony, automatic signals and all, three pages of musical instruments, the Zeiss binocular and, of course, wireless telegraphy. In the present instance, the introduction of these illustrative digressions is governed by so just a sense of proportion, and they are handled so well and are backed by so much thoroughly good physics of a more quantitative sort, that the result is much to be commended. It should always be remembered, however,— this is to be taken not as a criticism but as a warning — that this sort of thing may very easily become, in the hands of authors and especially of teachers less scholarly than Professor Millikan and Dr. Gale, an unfortunate return to the old-fashioned superficial, descriptive "natural philosophy" which they themselves so definitely deplore.

[1] Millikan, Robert Andrews and Gale, Henry Gordon, *A First Course in Physics*. Boston, Ginn & Co., 1906. 8vo, viii+488 pp.

Millikan, R. A. and Gale H. G., *A Laboratory Course in Physics, for Secondary Schools*. Boston, Ginn & Co., 1906. 8vo, x+134 pp.

Another interesting feature of these books is the free use which is made in qualitative explanations of such conceptions as the kinetic theory of gases, the ionic theory of electrolytic conduction, and the wave front in geometrical optics. Whether or not it pays, for instance, to displace the old ray-optics, which must, of course, be properly interpreted, by the more valuable but also more difficult notion of the wave front, is a question of pedagogy which each teacher must decide for himself. Fortunately the treatment of the most dangerously spectacular part of our modern physics is confined to the last twelve pages of the text-book, where there is an account, admirable as regards both interest and conservatism, of vacuum tube phenomena and of radio-activity, including some of the evidence for the existence of electrons, together with brief statements of the corpuscular theory of matter and of the disintegration theory of radio-activity.

Many other features, while not unique, are nevertheless worthy of much praise. For instance, the experiments, both for the laboratory and for the lecture room, are ingeniously simple and yet, so far as one can judge without trying them, entirely effective.

The typography is good, and the illustrations are most excellent, both in technique and in conception; and the sixteen full-page half-tones of eminent physicists, each with a short paragraph describing the man's life and work, are a notable addition not only to the attractiveness but to the real value of the books.

H. N. D.

BIOLOGY.

Jennings' Behavior of the Lower Organisms.[1]— It is now nearly a decade since Professor Jennings published his first brochure on the reactions to stimuli in unicellular organisms. The intervening period has been one of continuous activity on his part in the study of animal behavior, especially among the lower organisms. His investigations have not been strictly confined to the Protozoa for among the score or more of titles of important contributions from his

[1] H. S. Jennings. *Behavior of the Lower Organisms.* Columbia University. Biological Series, New York, The Macmillan Co., 1906, 8vo, xiv+366 pp., illus. $3.00.

pen are studies of the reactions of Metridium and of rotifers. Nor have his investigations been limited to the animal world alone for groups on the border lines such as the flagellates and bacteria have also been included. All students of these groups and especially investigators of animal behavior and workers in the field of comparative psychology will find cause for congratulation in the fact that Professor Jennings has taken this opportunity to resurvey the whole field of his experimental work and to summarize and restate his conclusions in this most important field of research. While many studies in this field have been made primarily from the standpoint of the psychologist, or have been of a desultory character, or are but partial in scope, the work summarized in this book has been dominated by the broadest scientific spirit, has been conducted with the greatest care and thoroughness, has included in its scope all possible avenues of approach to the analysis of animal behavior, as exemplified in the simplest organisms, and has been carried through to a stage of completion where fundamental generalizations are possible. The work of others in this field whether in agreement or not, with the author's conclusions, is treated with fullness and fairness. The book thus becomes an exemplification of the value of intensive research, an indispensable authority for any who wish to become familiar with the latest results in the field of animal psychology. As illustrative of the thoroughness with which the analysis has been carried out we find that in Paramecium the structure and the normal movements are described and correlated, and the reactions to chemical and mechanical stimuli of various sorts determined, the absence of reaction to light but the sensitiveness to the ultra-violet rays noted, as are also the reactions to heat and cold, to induction shocks and a constant current of electricity, to water currents, gravity, and centrifugal force. The relation of these actions of orientation to other reactions is carefully analyzed. The behavior of Paramecium in daily life in the aquarium, in fission and conjugation, under two or more stimuli, are all passed in review and the variability and modifiability of reactions is determined. The author concludes from observations on the differences in behavior of individuals that we find in Paramecium slight beginnings of the modification of behavior through the previous experiences of the organism. In the case of Stentor the same individual does not always behave in the same way under the same external conditions, but the behavior depends upon the physiological condition of the animal. The reaction to any given stimulus is modified by the past experience of the animal, and the modifications are regulatory, not

haphazard, in character. The phenomena are thus similar to those shown in the "learning" of higher organisms, save that the modifications depend upon less complex relations and last a shorter time.

Each organism is found to exhibit a set of actions made up, in the case of the lower organisms, of a few factors combined in various ways in a coördinated system which Professor Jennings designates as "the action system." For the term "motor reaction" employed in his earlier papers the phrase "avoiding reaction" is now used to designate the stereotyped method of reaction of Infusoria to most stimuli. The author rejects the local action theory of tropisms as a "more or less artificial construction, made by combining certain elements of behavior and omitting others that are of most essential significance." In its place he proposes the method of "trial and error" as an explanation of behavior. The stimulus interferes with definite internal processes occurring in the organism and this interference causes a change in behavior and varied movements which subject the organism indiscriminately to many different conditions. It merely acts in all sorts of ways possible to it. When one of these new conditions thus met relieves the organism from the existing interference with its life processes, the trials cease.

As a second cornerstone in the formulation of behavior we find the law of "resolution of physiological states" thus stated: "The resolution of one physiological state into another becomes easier and more rapid after it has taken place a number of times." It appears that even in Stentor and Vorticella repetition of an action brings the second step in a sequence in behavior more quickly upon the first. Here lie the foundations of the phenomena which are usually designated as habit formations, memory and learning, and the question may well be asked whether they are not coëxtensive with life and based fundamentally on the physical and chemical structure of colloids.

C. A. K.

Modernized Darwinism.[1] — Professor Guenther has written a very readable book on Darwinism and allied biological problems which the tyro will find quite intelligible. The translation seems good and the publishers have done their part well. The treatment of the subject is rather novel, most of the chapters being divided tax-

[1] C. Guenther. *Darwinism and the Problems of Life.* Translated from the third edition by Joseph McCabe. London: A. Brown & Co., 1906, Dutton & Co., New York, American agents. 8vo, 439 pp.

inomically under the headings mammals, birds, reptiles, and amphibians, etc. The group names, however, merely serve as hooks on which to hang certain biological discussions. Thus, under mammals are considered: protective coloration of hairy coats, hibernation, play of animals; under birds, sexual selection and migration; under reptiles and amphibians, the death of species and the origin of aërial life; under fishes, the origin of terrestrial vertebrates, rudimentary organs, and the biogenetic law; under insects, mimicry, instincts, inheritance of acquired characters; under crustaceans and molluscs biochemistry, parthenogenesis, and the meaning of sexual reproduction; under worms and cœlenterates, the descent of animals, parasitic life and symbiosis; under Protozoa, the principle of division of labor, the origin of the germ cells, and outlines of a theory of heredity. This arrangement does not lend itself to a systematic and logical development of the subject but the result is easy and delightful reading.

Not only is the book interestingly written but it is also a perfectly safe one. No evolutionary heresies tarnish its pages; nothing but simon-pure, orthodox natural selection is permitted here. Of course, as befits a scientific book, reference is made to de Vries's mutation theory and that of orthogenesis. The former is quickly disposed of in a couple of pages by stating first, that it cannot account for adaptations because with each mutation many or all parts change and all the changes cannot be adaptive. Secondly, an arising mutation will be swamped by intercrossing with the original stock. "Hence the multiplicity of our actual species cannot be due to mutations." Now that we know that species *cannot* be due to mutations it is to be hoped that people will please stop speaking about them. Similarly in regard to orthogenesis the theory is stated in one paragraph and then — "we need not delay long with this theory, because we know that the foundation of it is unsound." Thus authority speaks and an obedient scientific world will quickly forget that the theory was ever held by anyone. The folly of any other theory of evolution than Darwinism of the Weismannian brand is overwhelmingly demonstrated in every chapter by persuasive arguments and appealing examples. The necessary limitations of natural processes are so clearly set forth that the investigator has only himself to blame if he wastes time investigating any other theories of evolution; for, has not the author shown that they are all impossible?

C. B. D.

Momentum in Variation.— It is a little late to criticize an article that appeared in November, 1905, nevertheless I should like to say a word or two in regard to the paper by Mr. F. B. Loomis entitled "Momentum in Variation." The conclusion is reached that a variation started along any line tends to carry that line of development to its ultimate, being driven by momentum. If the feature is detrimental, the group dies out. If, however, it is merely a minor feature, it makes a handicap.

No one doubts that in the course of evolution, specialization goes so far as to carry a given species or group out of existence, but that this is of such widespread occurrence as Mr. Loomis implies, is open to doubt. Certainly the statements which he adduces to support this theory, are in many cases erroneous and in other instances open to quite other deductions than are placed upon them.

The few comments here given, are not at all in the line of captious criticisms, but are merely intended as a protest against any such short-cut to a solution of important problems as that taken in the paper in question.

If we begin with the Saber-toothed Tigers, which are cited as examples of extinction due to overdevelopment, we may go back about twenty years to the time when Professor Cope reached a similar conclusion, saying in the course of some discussion that Smilodon undoubtedly became extinct because it could not obtain food, whereupon someone present arose and said: "Mr. Cope, what did the Smilodon feed on"? In connection with this Dr. Matthew has recently brought forward some facts tending to show that the long tusks of Smilodon were of service in cutting through the long hair and thick hide of some of the contemporary ground sloths. Certainly if the tusks of Smilodon caused its extinction, why does not the Walrus die out for a similar cause? The Mammoth with its extreme development of tusks is also cited to illustrate the principle of momentum in variation, leading to extermination, but the great Gangetic elephant which shows the most enormous development of tusks, became extinct long ago, while other members of the race whose tusks were far more recurved lived on. Nor did those mastodons in which the tusks were greatly curved, come to an untimely end one whit sooner than their contemporaries with fairly straight tusks. The African Elephant, which is much the most primitive in structure of existing species, and more nearly resembles *E. ganesa* in tusk development, is the species that has thrived best. Moreover, the African elephant is the one in which tusks are present in both sexes while a large proportion of the

females of Asiatic Elephants are tuskless, so that here we have a case in which tusk development has gone beyond sex differentiation.

If Babirussa seems to be handicapped by its teeth, though there is another side to the case, how about Mesoplodon, in one species of which the teeth lock over the beak so that the animal can open its mouth for a short distance only and yet shows no signs of passing out of existence.

The elongation of the snout of Teleosaurus is cited as another disadvantageous character but the Gangetic Gavial in which the snout is nearly as long, finds this of great service in catching fish, as undoubtedly Teleosaurus did, and Dr. Abel gives elongation of snout as characteristic of fresh-water cetaceans.

Stegosaurus did not come to an end on account of its heavy armor but from some other cause, for the active predatory dinosaurs, such as Allosaurus, that were unincumbered by any defensive armor, died out just as did their heavier-plated contemporaries. The male Narwhal which has a single long tusk lives in the same sea and just as long and happily as his tuskless spouse, and many similar instances might be cited. The problem of the extinction of animals is far too complicated to be decided in haste and few of the examples cited by Mr. Loomis seem to be conclusive.

F. A. Lucas

Xenia in Wheat.[1] — As everyone has noticed, when white sweet corn is pollinated with red corn the outer part of the grains, although not truly part of the embryo, is red. This is a case of so called xenia. Xenia has been observed in other cases also, notably in beans and in wheat. Tschermak has recently studied xenia in wheat in more detail. He experimented with two races — the Hanna wheat and the Petkus wheat. Both kinds of wheat when in bud yield both green and yellow seeds; but yellow Hanna wheat gives 80% of yellow grains and green Petkus wheat breeds almost pure (95% of green seeds). The green Hanna and the yellow Petkus wheats when inbred yield only about half of their own kind respectively. Tschermak finds that when green and yellow Hanna wheats are cross-bred the seeds resulting show the color of the mother stock, whichever is so used. Likewise when the green and the yellow Petkus wheats are crossed

[1] Tschermak, E., "Ueber Züchtung neuer Getreiderassen mittels Künstlicher Kreuzung, II." *Zeitschr. f. d. landw. Versuchswesen in Œsterreich*, 45 pp., Feb., 1906.

the seeds have only the maternal color. On the other hand, when the opposite colors are derived from different races, and, especially, when the father is either yellow Hanna or green Petkus, the paternal character shows strongly on the seeds. Consequently, xenia is better manifested in wheats that are not very closely related than in those that are.

C. B. D.

ZOÖLOGY

Folsom's Entomology.[1] — Dr. Folsom's new work occupies a unique place among entomological text-books. As stated in the preface, "the book was written in an effort to meet the growing demand for a biological treatment of entomology." To this end the systematic side of the subject has been confined to a mere outline of the orders, following essentially the system of Brauer. The external anatomy, too, has been very briefly touched upon as that has been emphasized by the current texts.

On the other hand, there is an admirably clear-cut discussion of the elements of internal anatomy and of physiology. The value of this chapter lies not only in the careful organization of the material presented but in the omission of a vast amount of detail. The author has followed a common error in stating that the alary muscles are unstriated. He speaks of the follicular cells of the ovary as derived from the primitive germ cells,— a view which is not held by recent investigators of this subject. In view of the decisive work of Petrunkewitsch and other of Weismann's students one is surprised to see, p. 145, the statement that "males may, of course, result from fertilized eggs, as in the honey-bee, according to Dickel."

The chapter on development likewise shows the virtue of vigorous pruning. There is a very brief but excellent outline of the embryological development, while the greater portion of the chapter is devoted to the postembryonic development.

[1] Folsom, J. W. *Entomology, with Special Reference to its Biological and Economic Aspects.* Philadelphia, Blakiston's Son & Co., 1906. 8vo, vii + 485 pp., with 1 col. pl. and 300 illustrations.

The remainder of the text is largely devoted to biological phases of the subject. Much material which is not accessible in any other text is here brought together and is treated from a broad biological view-point. The subjects of color and coloration; the origin of adaptations and of species, distribution; the relation of insects to plants and to other animals; their interrelations and their behavior, are treated in a concise but most readable and interesting manner.

Though the method of treatment is professedly economic as well as biologic, the practical aspect of the subject receives but scant attention. The relations of insects to plants, and to other animals, are discussed from the view-point of the biologist. Six pages are devoted to an excellent summary of the important subject of the transmission of disease by insects. The sixteen pages on insects in relation to man are largely given over to a statement of the importance of the subject and to an historical sketch of the progress of economic entomology in America.

The illustrations are excellent and, in many cases, new and prepared by the author. Such as have been copied are very carefully credited. An extensive and carefully arranged bibliography will be very helpful to the student.

Dr. Folsom is to be congratulated on the clear, concise, and interesting presentation of his material. The book is one which is bound to prove stimulating, and which every worker in the field of entomology and every teacher of zoölogy will want in his own library. Whether it will meet the present day demands for an entomological text-book is a question.

W. A. R.

Additional Observations on Hyla andersonii and Rana virgatipes in New Jersey.—An effort was made this past summer to add to the observations on *Hyla andersonii* and *Rana virgatipes* published in two previous numbers of the *American Naturalist.*

It was observed in June at Lakehurst that the males of *Hyla andersonii* were attracted to a few small pools in particular, several of which were only a yard or two in diameter. On July 21st, with Mr. James Chapin, I made search in these pools for the tadpoles, and was fortunate in finding a number in one pool, though they appeared to be absent from another and similar locality about a mile distant where the adult frogs had been and were still most numerous. The tadpoles collected were in all stages from a few millimeters long to those just leaving the water as little frogs. The mature tadpoles are from 35 to 40 mm. long and of the usual tadpole color, that is, of the color of the

muddy bottom of a pool. The under parts are lighter and show a golden sheen, which sometimes extends up the sides. The small hind legs show early on the ends of the toes the disks that are so conspicuous in the mature Hyla. The tail is spotted, and there is usually a dark irregular marginal band. The maculations sometimes become irregular blotches as on the tails of the tadpoles of *Hyla versicolor*. When the tail is nearly absorbed, and they leave the water, they are about 25 mm. long and of a dull olive green. They grow lighter, that is, brighter green in hue with the disappearance of the tail, until the little frogs, which in length of body are 15 mm., resemble the mature individuals. The white that margins the green of the back and extremities is not so conspicuous as in the adults, and the saffron of the under parts is wanting in those that I have examined. The narrow band of purplish brown that commences at the nose and extends through the eyes and so down the sides is conspicuous in the little frogs before the last remnant of the tail has disappeared.

The adult *Hyla andersonii* is amusingly active at night and jumps about the lower limbs of the trees and on to the bushes with much agility. They seem rarely to climb over five or six feet from the ground. They sit upright and look pert, and if interrupted in the midst of their song they leave their bubbles blown up until such time as the intruder goes away or stands still. In the day time they are usually quiet and for the most part hide in the damp moss and leaves lying on the ground.

On the warm cloudy evening of August 10th, *Hyla andersonii* was heard near some pools a short distance north of the village of Farmingdale, N. J. This locality is 15 miles northeast of Lakehurst, which has been the most northern locality for the frog heretofore recorded.

Rana virgatipes may be called the Carpenter Frog, for its note sounds much like the blow of a hammer on a board. It is a quickly uttered *chuck-up, chuck-up*, and the frog usually hammers from three to four times. For a time I was not sure of the singer, but some captive individuals under the influence of good living have uttered this call-note in my room while I sat by. These frogs domineer over one another to some extent, and when insects were placed in the cage as food, it was common for the more active individual, failing in the attempt to catch a fly, to turn on his companion and butt him until he retreated into the pool or into a corner. The butted individual would hold his head down in the meekest manner, and he became so cowed that if I touched him at any time with my finger, he assumed the humble position. Miss Dickerson in *The Frog Book* says that

Rana pipiens and *Rana onca* will snap at the head of a companion frog that has taken a worm that he was trying to capture, but she thinks it is probably not an exhibition of anger, but a desire to secure the disappearing worm. However this may be, it is certain that the butting *Rana virgatipes* in the above-mentioned case secured a great advantage over the other frog, for after "settling" his companion, he captured all of the insects.

WILLIAM T. DAVIS

Zoölogical Laboratory Notes.— In the form of loose leaves bound together so that they can be individually removed, T. H. Sheffer[1] has prepared a set of laboratory notes on about two dozen common animals. Such notes are usually so arranged as to excite in the student a desire to study the material before him; this set described rather fully what he "ought" to see and is well calculated to kill any real growing interest he may have. The author thinks the notes should commend themselves to teachers "by reason of certain special advantages and a simple and rational treatment in general."

Notes.—*Circulatory Organs of Diotocardian Gastropods.* The study of the heart of the diotocardians by Spillmann ("Zur Anatomie und Histologie des Herzens und der Hauptarterien der Diotocardier." *Jen. Zeitschr. f. Naturwiss.*, vol. 40, pp. 537–538, pls. 19–21) justifies the separation of the Rhipidoglossa from the Docoglossa. In the Rhipidoglossa the pericardial chamber is penetrated by the intestine, and there are two auricles. While the auricles are thin-walled and deficient in muscle, the ventricle has a thick muscular wall of three layers. The openings from the auricles to the ventricle are guarded by lamellar valves. In the Docoglossa the intestine does not penetrate the pericardial chamber, and only the left auricle is present. This has the same structure as in the Rhipidoglossa, but the ventricle of the Docoglossa shows only two of the three layers seen in the Rhipidoglossa. In the Docoglossa the opening from the auricle into the ventricle is provided with a tubular valve. Nerita forms an interesting transition between these two groups so far as the structure of its heart is concerned. It may be called a docoglossan with a penetrated pericardial chamber or a rhipidoglossan with lamellar valves.

Goblet Cells in the Epidermis of Fishes. According to Oxner

[1] Scheffer, T. H. *The Loose Leaf System of Laboratory Notes.* P. Blakiston's Son & Co., Philada., 1906, 112 pp.

("Ueber die Kolbenzellen in der Epidermis der Fische." *Jen. Zeitschr. f. Naturwiss.*, vol. 40, pp. 589–646, pls. 22–26) goblet cells occur in the epidermis of cyclostomes and most physostomous teleosts. All goblet cells are modified epithelial cells from the deepest or germinal layer of the epidermis. They are undoubtedly specialized unicellular glands which may have in addition some supporting function.

The Selachian Eye. From a study of the eyes of some eighteen species of sharks and rays Franz ("Zur Anatomie, Histologie, und functionellen Gestaltung des Selachierauges.' *Jen. Zeitschr. f. Naturwiss.*, vol. 40, pp. 697–840, pl. 29), has shown that while there are many specific differences, the eyes of this group as a whole are clearly distinguishable from those of other vertebrates. What is especially peculiar in them is the tapetum lucidum, an epithelial musculature in the iris instead of the usual mesodermal one, a specialized zonula zinnii, and the absence of a falciform process characteristic of other fishes. The adaptations shown by the eyes of different species are discussed at some length.

G. H. P.

BOTANY

Bergen and Davis's Principles of Botany.[1] — One of the most successful American elementary botanical text-books has been Bergen's *Foundations of Botany.* With its author, Dr. Davis has been associated in the preparation of the present book, which is certain to find favor with the users of its predecessor and to win many new friends since in addition to what was best in the earlier text there is now given a consecutive series of studies of representative spore plants so treated as to outline the evolutionary history of the plant world. Both authors are experienced teachers, and also familiar with research problems at first hand, and they have brought to their task unusual care in grouping and handling the subject matter and in well illustrating it.

The book is said to furnish material for a full year's work. It contains, indeed, enough to occupy considerably more than this time,

[1] Bergen, J. Y., and Davis, B. M. *Principles of Botany.* Boston, Ginn & Co., 1906. 12mo, ix + 555 pp., 14 pl., 402 figs.

if all of its topics were thoroughly worked over; but the purpose of its authors has been to present somewhat more than is likely to be used, so that individual teachers may find it comprehensive enough to base on it courses adapted to their several needs. It is safe to say that it will be a much consulted book even in laboratories where other manuals are used to outline the courses given.

W. T.

Rydberg's Flora of Colorado.[1] As a precursor to his flora of the entire Rocky Mountain region, Dr. Rydberg has prepared a manual of the Pteridophytes and Spermatophytes of Colorado, which, for extent and carefulness of work stands well to the front among our State floras. Forty-nine orders, 134 families, 702 genera, and 2912 species find representation in it. The nomenclature used is essentially after the Philadelphia Code. Generic limits are confessedly rather radically close, and the same may be said of the limitation of species. Apparently good keys are given for the higher groups, genera, and species; but descriptions are limited to these, though ample data are given as to habitat, distribution, etc., and considerable synonymy is added.

W. T.

Notes:—The recently issued fifth volume on the Congress of Arts and Science, held in connection with the Louisiana Purchase Exposition of 1904, (Boston and New York, Houghton, Mifflin & Co., 1906) deals with Biology, Anthropology, Psychology and Sociology, and contains the following addresses of botanical interest:—Coulter, "Development of Morphological Conceptions"; Loeb, "The Recent Development of Biology"; De Vries, "A Comparison between Artificial and Natural Selection"; Bower, "Plant Morphology"; Goebel, "The Fundamental Problems of Present Day Plant Morphology"; Wiesner, "The Development of Plant Physiology under the Influence of the Other Sciences"; Duggar, "Plant Physiology—Present Problems"; Arthur, "The History and Scope of Plant Pathology"; Waite, "Vegetable Pathology an Economic Science"; Drude, "The Position of Ecology in Modern Science"; Robinson, "The Problems of Ecology"; Jordan, "Relations of Bacteriology to Other Sciences"; Smith, "Some Problems in the Life History of Pathogenic Micro-Organisms."

[1] Rydberg, P. A. "Flora of Colorado." *Bulletin 100, Agricultural Experiment Station of the Colorado Agricultural College*, Fort Collins, Col., 1906. 8vo, xxii + 447 pp.

The second volume of *Postelsia*, the Yearbook of the Minnesota Seaside Station, issued from the Pioneer Press of St. Paul, contains the following papers: — Rosendahl, "Observations on Plant Distribution in Renfrew District of Vancouver Island"; Butters, "The Conifers of Vancouver Island"; Evans, "Hepaticæ of Vancouver"; Hone, "Some Western Helvellineæ"; Griggs, "*Renfrewia parvula*, a New Kelp from Vancouver Island"; Henkel, "A Study of Tidepools on the West Coast of Vancouver Island"; and Hall, "Some Geological Features of the Minnesota Seaside Station."

The weaving of stem and branches into a pseudo-trunk, by their aërial roots, is described and figured for Hemitelia by Schoute in vol. 20, part 2, of the *Annales du Jardin Botanique de Buitenzorg*.

An illustrated paper on the medullary rays of Conifers, by Tassi, forms part of the recently issued vol. 8, fasc. 1–4, of the *Bullettino del Laboratorio ed Orto Botanico* of the University of Siena.

An illustrated paper on the leaf structure of certain New Zealand plants, by Miss Herriott, is published in vol. 38 of the *Transactions and Proceedings of the New Zealand Institute*, which also contains other papers of botanical interest.

A study of unlignified cellulose in certain wood cells, and of the cellulose skeleton remaining after the delignification of others, is separately issued by Spaulding from the 17th *Annual Report of the Missouri Botanical Garden*.

Non-nitrogenous food reserves, and irritability, occupy a large part respectively of the recently issued first and sixth volumes of the *Recueil de l' Institut Botanique Léo Errera*, of the Brussels University.

Part 11 of Koorders & Valeton's "Additamenta ad Cognitionem Floræ Arboreæ Javanicæ" has recently been issued at Batavia as no. 2 of the *Mededeelingen uitgaande van het Departemente van Landbouw*.

An account of the botany of Christmas Island, by Ridley, is contained in the recently issued no. 45 of the *Journal of the Straits Branch of the Royal Asiatic Society*.

Considerable attention is given to Natural History in Sir Harry Johnston's book on Liberia (London, Hutchinson & Co., 1906, 2 vols.), an appendix on the flora being contributed by Stapf.

A number of generic segregates are published by Greene in the signature of his *Leaflets* issued on September 8th.

A considerable part of the June number of the *Revista de la Facultad de Agronomia y Veterinaria* of the La Plata University is occupied by an illustrated account of *Ilex paraguayensis* and its commercial preparation, by Uzal.

Ribes viburnifolium is figured in *Curtis's Botanical Magazine* for September.

A further discussion of *Primula obconica* and its poison, with figures of the glandular hairs, is contributed by Weydahl to *Gartenflora* of Sept. 1.

An illustrated monograph of the typical varieties of *Nicotiana tabacum* by Anastasia, has been issued from the *R. Instituto Sperimentale Tabacchi*, of Scafati, Italy.

Sprenger briefly describes his hybrids of *Yucca aloifolia* in the *Bullettino della R. Società Toscana di Orticultura* for August.

A fine flowering mass of *Yucca recurvifolia*, as grown at Kew, is figured in the *Gardeners' Chronicle* of August 18.

A sumptuous quarto volume on American fossil Cycads, by Wieland, has been issued as *Publication no. 34* of the Carnegie Institution of Washington.

A paper on the cytology of Entomophthoraceæ, by Riddle, forming no. 63 of the "Contributions from the Cryptogamic Laboratory of Harvard University," occupies vol. 42, no. 10, of the *Proceedings of the American Academy of Arts and Sciences.*

A number of new Philippine ferns are described and figured by Copeland in vol. 1, supplement 2, of *The Philippine Journal of Science*, issued on June 15.

Palmer contributes a paper on the nature of Diatom motion to vol. 1, no. 4, of the *Proceedings of the Delaware County Institute of Science*, of Media, Pa.

Papers on chromogenic fungi which discolor wood, and the zonation of artificial cultures of certain moulds, by Hedgcock, have been separately issued from the *17th Annual Report of the Missouri Botanical Garden.*

An illustrated synopsis of Portuguese galls is given by Tavares in *Broteria*, vol. 4.

The dune-fixing planting of Cape Cod is illustrated by Birge in *The American Inventor* for September.

An illustrated forestal account of Sequoia is given by Sterling in *School Science and Mathematics* for October.

A series of "Botaniker Porträts," each accompanied by a short but comprehensive biographic sketch, is being issued in quarto fascicles by Dörfler of Vienna. Judging from the two fascicles thus far issued, the quality of execution and accuracy of text are unimpeachable.

Kellogg contributes a paper on the scientific aspects of Luther Burbank's work to *The Popular Science Monthly* for October.

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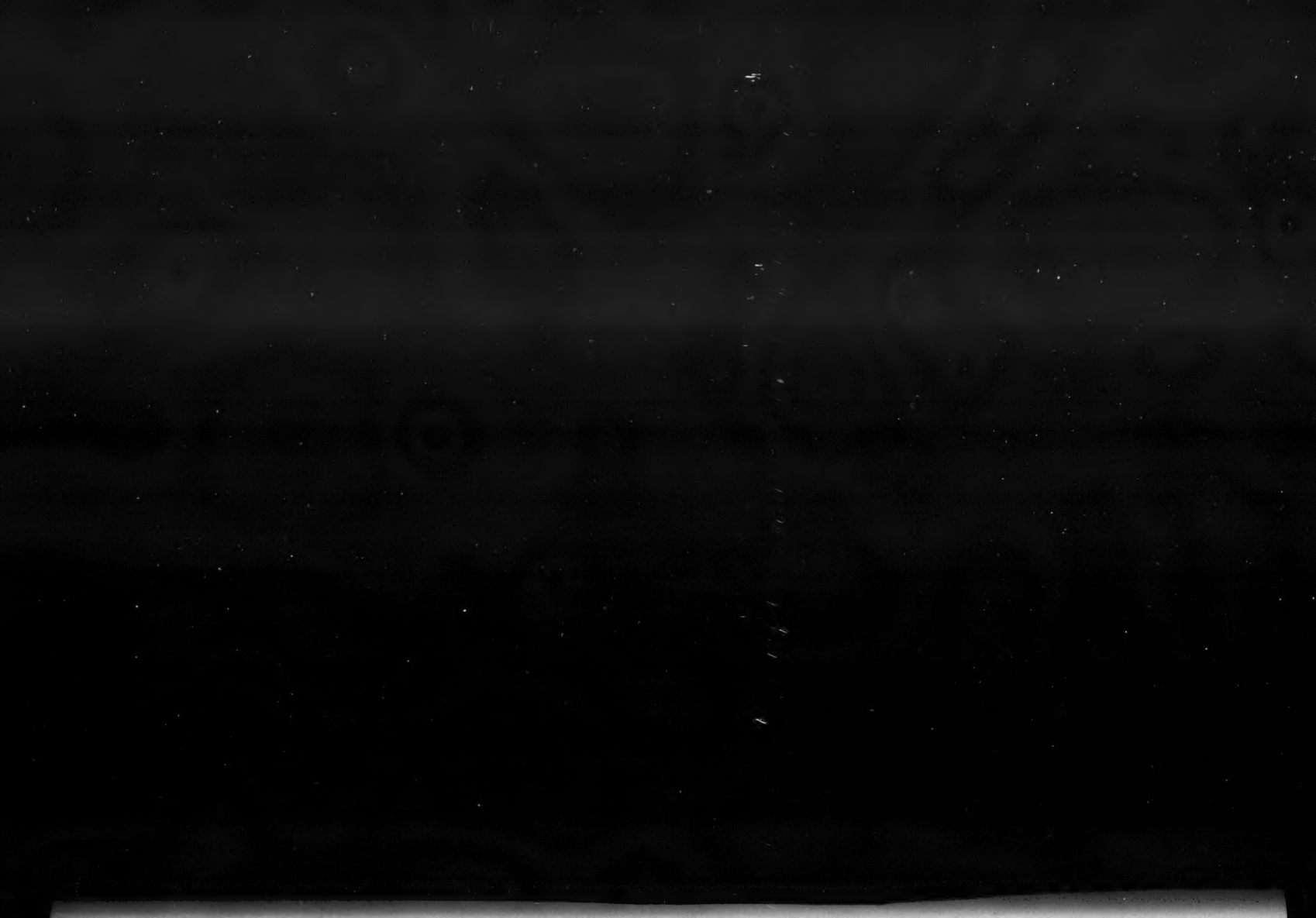
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